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## ENGINEERING/TECHNOLOGY

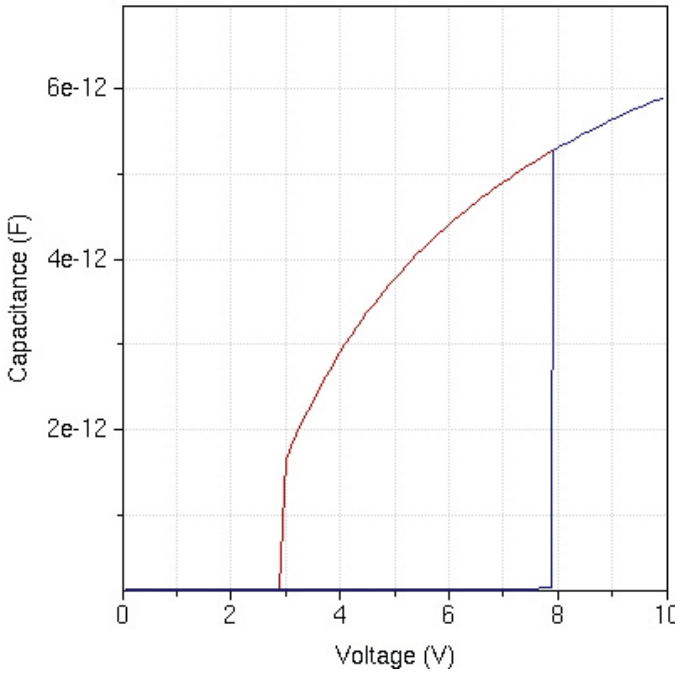
### Microelectromechanical Systems Lab Simulation Tool

Student researcher: Oluwatosin Adeosun, Senior

Radio frequency microelectromechanical systems (RF MEMS) actuators are electrically actuated mechanical switches in the micrometer and nanometer scale. These actuators have applications in wireless communication, smart phones, and radar systems, among other things. In comparison to other switches, RF MEMS switches have the advantage of lower power consumption and better electrical isolation. In this study, we develop a simulation tool on NanoHUB for RF MEMS actuators that describes the characteristics of the actuator, using both compact models and numerical simulations.

The actuation characteristics assist in predicting the behavior of an electromechanical switch. These characteristics are represented in the form of plots showing the relationships between capacitance and beam position, with respect to applied voltages and the time evolution of capacitance and beam position on application of specific inputs. The simulation tool requires users to enter the dimensions, material, and geometry of the actuator. The user can chose between applying either a compact model, which determines the actuation characteristics based on universal scaling relationships of the different types of actuators, or a numerical simulation, which is slower but can perform more complex dynamic analysis of the actuators. The compact model has shown to be accurate for steady-state DC voltage analysis. The numerical simulation approach determines the actuation characteristics using a finite difference method approach to solve the Kirchhoff-Love plate equation. The tool has supported over 800 simulation runs by 58 users as of April 14, 2014, and has been used in assignments as part of the NanoHUB-U course "Principles of Electronic Nanobiosensors."

*Research advisor Muhammad Alam writes, "Microelectromechanical switches are unique for their history, physics, low-power dissipation, and broad range of existing and potential applications. Using considerable computer skill and disciplined/dedicated effort, Oluwatosin transformed a research-grade MEMS modeling software (developed by multiple graduate students that might have otherwise perished in individual computers when the students graduate) and made it accessible to the world."*




Capacitance-voltage characteristic curve for a cantilever beam geometry with a compact model simulation.

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